and participating in one's active life with other persons (see References for Chapter Ten: 2, 5). Multiple exposures lead to better control and increase awareness of these effects.

The relationship of any residual stimulus to these needs is carefully evaluated. "Negative and positive" transference problems arise from extremely small and unlikely kinds of stimuli under these conditions; i.e., a "wrong" word, too many suggestions, implied judgments of accuracy or performance, or their "positive" opposites. The safety man must be, as it were, an ideal and keenly aware diplomat when faced with such problems. It has been found that having once experienced the lowest possible level of stimulation oneself makes it very much easier to function as a "diplomatic," tolerant, and considerate safety man. Hurt feelings, overenthusiastic reactions, and replication of experience reported by others are examples of the kinds of phenomena to be found and dealt with.

The positive, enjoyable results were achieved only at those times when the inner and the outer disturbing stimuli were minimizable. Any residual discomfort made it impossible to achieve the euphoric state; any anxiety induced by faulty apparatus or technique blocked the possibility of enjoying or profiting from the experience. Until we were able to attenuate physical discomfort and fear by better techniques, multiple exposures, and careful training, we saw mostly "negative" phenomena. As the levels of stimuli were lowered closer to zero, the positive, more blissful, enjoyable states and the positive transference phenomena appeared. No addiction to these states has occurred: the internal satisfactions of needs achieved in the tank are limited in the same sense that, say, day-dreaming is limited. Basic satisfactions of needs felt in the tank require later exchanges with other persons and with physical reality.

As has been published (see References for Chapter Ten: 1, 2), it is felt that such experiences are not necessarily psychotic, or even mentally aberrant, and after training can be constructive and invigorating. Eventually, after many exposures, each subject can learn enough to enjoy and not fear or dislike his own experiences.

CHAPTER ELEVEN

Standards for Isolation Tank Manufacture and Use

The standards are those we have found necessary for reliability of operation, for safety, and for maintenance of a reasonably hygienic environment. Low cost of operation and safety are favored over low initial investment; if a more expensive item meets our standards and decreases the cost of operation we use it rather than a less expensive item that may be less reliable, unsafe or costly to operate in the long run (one year or more). A cheaper item may end up generating far more cost in terms of unreliable operation, redesign cost, time spent on its maintenance, anxiety over its unsafe operation, and its potentially unhealthful effects on persons using the tank.

In the experience of over twenty years of tank design, maintenance and personal use, we have arrived at the above point of view. After one has been in coma because of a failure of control of the solution's temperature, experienced electrical shocks, run out of air, received skin infections from the water, lost valuable solutions through leaks, dealt with plugged too small filters, blown fuses through shorts in the electrical systems, dealt with corroded pumps and lines, found toxic amounts of copper in the solution, paid high electrical bills because of lack of adequate heat insulation on the tank, cleaned up salts left on house floors and carpets etcetera, one becomes conservative, cautious and expert at avoiding such contingencies in the future. In short, one learns that a high initial investment may be necessary to avoid high future operating costs of all types, including threats to health and happiness.

IDEAL PROPERTIES OF AN ISOLATION TANK

1. Thermal insulation is optimal to the point where the heat loss from the flotation solution and from the air over it is so low that only a very small or zero outside source of energy is needed to maintain the 93° to 94°F temperature when a person is floating in the tank. The heat from the body metabolism maintains this temperature, neither raising it nor lowering it. Zero loss of heat is to be avoided; the body would then raise the temperature of the solution. The body temperature would then rise. Thermal insulation, then, should be such that the steady state heat loss with a person in the tank is slightly greater than the basal metabolic heat production of the body of a person with basal metabolism up to three standard deviations above the mean for the human population expected to use isolation tanks. A rough approximation of the energy produced is 80 to 90 watts in these cases.

2. Available air supply is optimal when the oxygen, carbon dioxide and water vapor content are maintained within physiological limits and no noxious gases or unpleasant odors are added to the tank air from the outside air supply. No possible sources of the following substances are to be allowed in the air supply: carbon monoxide; natural gas; methane; propane; butane; Freon; bug sprays, paints and thinners; acetylene; ethylene; nitric, hydrochloric and sulfuric acid; battery gases; helium, hydrogen; nitrous and nitric oxide; krypton, xenon, radon; radioactive gases (liquids and solids); hydrogen sulfide; no particulate solids or droplets of noxious solids or liquids.

Physiological limits, after four hours' exposure: The oxygen shall be at 20 percent atmospheric pressure minus less than 2 percent. The carbon dioxide percentage shall not be more than 2 percent integrated over the four hours. Water vapor percentage shall be that at 90 percent humidity at 90° to 94°F within a few percent.

3. Solution temperature: The temperature of the flotation solution shall be maintained at a fixed value between 93° to 94° within 0.1°F in the fully stirred condition. It is desirable to be able to set this temperature at a fixed value in the range 93° to 94°F and maintain it within ±0.05°F. A suitable thermometer for measuring these temperatures is ASTM number 51F (range 69° to 116°F, eighteen inches long).*

4a. Solution density: The lowest desirable density in gms./cc. is 1.30. This value corresponds closely to a specific gravity of 1.30, determined by a sensitive hydrometer † readable to 0.001 gms./cc. This density is to be achieved and maintained by using clean tap water and approximately 53 percent by weight of commercial magnesium sulfate: $MgSO_4 \cdot 7H_2O$ (hydrated salt). See Table 1, Chapter Two, for relations between solute (hydrated and nonhydrated salt) solution percentages and solution densities, resulting from various concentrations at a given temperature. A suitable hydrometer for the measurements of solution densities is one with a range of 1.200 to 1.4200 specific gravity. (Refer Table 1, p. 31.) †

4b. Mixing for 1.30 density: The desired solution density is obtained by using enough ($MgSO_4 \cdot 7H_2O$) commercial Epsom salts to saturate the solution at 93°F; one mixes proper weights of Epsom salt and of water at 140°F; the endothermic reaction brings the mixture to 93°F.

Determination of the weight of hydrated magnesium sulfate to add to water to make a solution of high density for flotation in the isolation tank (approximate values, within 1 percent):

Desired density = 1.30 gms./cc.
Specific gravity = 1.30.
The hydrated magnesium sulfate contains 51.0 percent water.
For a given weight of the hydrated salt 51.0 percent is water of hydration (H_2O).
For the usual commercial 100-pound bag, 51.0 pounds is water (H_2O), and 49.0 pounds is the dry salt ($MgSO_4$).
Only the salt ($MgSO_4$) increases the density of the solution; the water of hydration (H_2O) only adds to the volume of the solution.
The working temperature of the solution in the tank is 93.2°F or 34.1°C.

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* Catalog no. 61096–003 page 1196 in *VWR Scientific Apparatus Catalog*. Catalog no. 72 (September, 1971), P.O. Box 2062, Terminal Annex, Los Angeles, Ca. 90054, cost approximately $6.

† See Catalog no. 34615–006, hydrometer range 1.200–1.420, 12 inches long; or no. 34680–008, specific gravity range 1.15–1.30, in syringe for ease of use, page 720 in *VWR Scientific Apparatus Catalog*.

The density of water at 93.2°F (34.1°C) is 0.994 gms./cc.

The equivalent density of the dry salt is 2.16 gms./cc. in solution.

For a solution density of 1.30, the following table of values gives the fractions involved:

		Percent by weight	per cc. (gms.)	per cubic foot (kgms.)		per cubic foot (pounds)	
73.7%	Added H_2O	46.36	0.4608	13.048	36.83	28.71	81.02
	Hydration (H_2O)	27.34	0.2718	7.6965		16.93	
	Dry salt	26.30	0.5680	16.084		35.38	
	(Hydrated salt)	(53.64)	(0.8398)	(19.755)		(43.46)	

From this table one can calculate the amount of commercial hydrated salt needed for a given tank to give a solution of density equal to 1.30 gms./cc.

EXAMPLE: A tank 7½′ by 3½′ with a depth of 10″ of solution:

$7\frac{1}{2}' \times 3\frac{1}{2}' \times 10/12 = 21.9$ cubic feet

43.46 pounds of hydrated salt are required for every cubic foot of solution.

The total weight of hydrated magnesium sulfate for this tank is thus: 21.9 cu. ft. × 43.46 pounds/cu. ft. = 952 pounds.

4c. Experimental determination of density: Over a temperature range from 74.4°F (23.6°C) to 103.2°F (39.6°C), the average weight of 10.0 cc. of saturated magnesium sulfate solution was found to be 13.07 ± .01 gms. The density in gms./cc. is 1.307 ± 0.01. Tap water by the same technique at 74°F (23.3°C) had a density of 0.9950 and at 105.8°F (41°C) was 0.993. (The accepted values for pure air-free water are 0.997 and 0.992 respectively.)

Therefore, we can assume the method gives the density of 1.30 close enough for all practical flotation purposes.

The solution from each of two tanks with saturated magnesium sulfate gave 1.30 ± 0.01 gms./cc. density.

As mentioned elsewhere, a hydrometer gives the density (specific gravity) more quickly and easily: use one with a range of specific gravity from 1.200 to 1.400.

5. Water supply: Reasonably clean tap water is used to make up the 50 percent plus by weight solution of hydrated magnesium sulfate. This water should not contain chlorine in a high enough concentration as to be odorous. The bacterial content should be less than that specified in the public health standards for city water supplies. The toxic inorganic ions should be below toxic levels for long repeated exposure of skin, including genitalia. Such ions include those of copper, arsenic, cadmium, mercury, lead, uranium, plutonium, etcetera.

The pH (acid–base balance) shall be within the physiological range for the normal human skin, genitalia and anus for chronic exposure (7.0±0.2).

6. Tank dimensions: wall and bottom contacts: The flotation area (surface of the flotation solution) shall be at least 7½′ (202 cm.) long × 4′ (108 cm.) wide. The solution depth shall be at least 10 inches (25.4 cm.). These dimensions have been found to be comfortable for individuals up to 6′ 6″ (175 cm.) in height. The smaller the individual the smaller the "Ping-Ponging effect." (Because of the low friction and the high mobility of the floating body, a contact with a wall resulting in even the slightest push-off force causes travel from wall to wall called "Ping-Ponging.")

A tank, larger in surface area than the above, improves the isolation by decreasing the frequency (increasing the time interval of wall contacts). A circular tank (8′ or 215 cm. in diameter) with a slowly rotating (one revolution every five minutes) solution was found to give no wall contacts during two-hour exposures. The drain was at the center of the circle; small jets directed in the direction of rotation were placed at the wall perimeter.

A square tank 8′ (215 cm.) on each side (with regulated convection currents; see below) gave no wall contacts over four-hour periods.

A rectangular tank 8′ (215 cm.) wide and 12′ (323 cm.) long (with regulated input–output flows; see below) gave no wall contacts over twelve-hour periods.

The depth of the solution at 10″ (25.4 cm.) was determined in a sequence of three hundred subjects as that depth at which the most steatopygic high-density individuals did not have bottom contacts in the gluteal regions. At 8" (18 cm.) some individuals went aground.

7. *Convection currents in the solution:* If the heaters are arranged in the bottom of the tanks correctly, the very slight resulting convection currents tend to hold the body in the center of the tank. (In rectangular or square tanks the heating elements, either electric or tubing containing hot circulating water, imbedded in the bottom are placed around the outer dimensions. In circular tanks the heaters are placed circularly around the perimeter.)

8. *Adjusted input–output flows:* In certain designs of tanks, a very small flow pattern of the solution can be used to center the body. In each case the output flow from the tank is placed under the center of buoyancy of the whole body (near the center of gravity) in the bottom of the tank. The input flows to the tank are near (but not at) the surface with at least three in each wall (twelve total) directed toward the body in the rectangular tanks. In the circular form, twelve to sixteen inlets are placed in the wall uniformly distributed.

Such flows are obtained from plastic plumbing fed by a very small plastic pump, removed from the vicinity of the tank to minimize noise introduced into the tank.

8a. *Filtration:* A ½ horsepower plastic pump and diatomaceous earth swimming pool filter (20 sq. ft. area) are used to filter the tank solution as needed to maintain a clear solution (once a week, depending on use hours).

9. *Light level:* In the visible spectrum, the light level at the eyes of the floating subject shall be subliminal for fully dark adapted open eyes in subjects with no night-blindness (adequate vitamin A intake). No ultraviolet radiation shall be allowed. Infrared radiation is restricted to that emitted by the body, the solutions and the ceiling—black-body emission of infrared radiation in the temperature range 98.6°F (37.0°C) to 93°F (33.9°C).

10. *Sound level* (20Hz to 100,000 Hz *): The level of sound energy in the solution throughout the acoustic spectrum shall be below the underwater threshold for detection for subjects with unimpaired hearing, measured re the reference level of 0.0002 dynes/cm^2.

11. *Vibration level* (20Hz to 0.1Hz): The vibration energy level in

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* A frequency of one cycle per second.

the solution shall be less than body threshold throughout the vibration spectrum for the most sensitive individuals. Any detectable vibration must be eliminated. Exceptions that cannot be eliminated are earthquake waves, large sonic–subsonic booms, explosions, nuclear blasts, etcetera.

12. *Electric and magnetic fields:* Electrical fields in the frequency range from direct current (0.Hz) to 100,000 Hz shall be below threshold for detection for normal human subjects. Power line frequencies (50 to 60 Hz) have the least energy threshold for nerve stimulation in this range and can be particularly dangerous. Power line fields (electrostatic and conductive) must be below detection levels for a grounded subject outside the tank touching the solution (an AC voltage difference less than 0.1 volt).

Oscillating magnetic fields at or near power line frequencies can cause oscillating phosphenes ("as if light") emanating from retinal-ganglion cell network stimulation in the eye. Such fields are to be eliminated or kept below threshold for phosphene production.

THE IDEAL ENVIRONMENT FOR THE TANK

The room or building in which the tank is housed and used must have the following specifications:

a. Remove from all social encroachment; no foot traffic, visitors, large or small animals, children, insects or other living organisms are allowed in the room or near the room.

b. The location for the room or building should be free of outside noise sources. The location should be as silent as possible. Within the room, exclude all noise, music and speech sources (no furnace, no refrigerator machinery, no hair dryer, no vacuum cleaner, no water pump, no radio, TV or hi-fi sets and so forth). Sound insulation both for transmission and reflection should be put upon the wall, ceiling and floor. This is an absolute requirement.

c. No daylight shall be allowed in the room. The light within the room shall be controlled. For cleaning the room and making adjustments to apparatus, bright lights are needed, also for maintenance of the tank itself. During tank use dim red lights (as in photographic darkroom) are used to prevent glare effects in the person emerging from the tank.

d. Electrical and thermal insulation of the floor is used to prevent electrical and/or thermal shocks through bare feet.

e. The room temperature shall be kept at approximately 86°F to prevent thermal shock to a person emerging from the tank. This temperature may seem too hot when one first enters the room and removes one's clothes.

f. A pleasing aesthetic appearance of the room is necessary for most persons. Be sure the room has carpets for example that are impervious to Epsom salts solution.

g. A shower bath should be installed either in the room or immediately adjacent to the room to prevent tracking of Epsom salts into the surrounding environs.

h. Some means of drying the body should be supplied. In general, towels tend to get extremely stiff when filled with Epsom salts solution and dried later. In general it is better if the shower is immediately available to get rid of the Epsom salts.

i. Some sort of toilet facilities should be immediately adjacent to the room, also. It is necessary to void urine and feces before going into the tank and to take a shower before entering the tank. We have found it is best if the person who is using the tank shampoos his/her hair before entering the tank, thus eliminating loose-hair problems in the tank filtration system.

RULES FOR TANK USE

In our experience we have found that persons with skin diseases should not use the tank unless they are prepared to protect their lesions with silicone or some other form of ointment that is waterproof. In general we do not encourage people who are in the midst of an infectious disease to use the tank. These are good public-health and hygiene measures. The inflammatory stage of any disease (the common cold, influenza, venereal disease, suppurative lesions, the early stages of traumatic cuts, abrasions and contusions) is inimical to other persons using the tank; however, during the initial stages of broken bones and similar traumatic episodes, the tank is an immense relief for the patient using it. Medical advice should be sought in the presence of any type of organic disease.

No persons with epilepsy are to be allowed to use the tank unless their epilepsy is under medical control, having sufficient control of the subject's seizures so they will not endanger themselves in tank use.

No person under the influence of drugs should be allowed in the tank. In the younger population that has used the tank, we have found that too much marijuana can lead to states in which the person cannot control his/her floating. He/she may end up under the water, taking the Epsom salts solution into the nasal and oral tract in such a way as to pose a potential danger. Drugs in general make a person less competent to handle the tank situation than he/she is when in the nondrug state.

No persons with severe mental illness should be allowed to use the tank except under extremely careful medical control.

No persons who have a tendency toward suicidal action should be allowed in the tank or anywhere near it.

We have found that there are certain types of personality that do not benefit from tank work. It is a moot point as to whether one prevents them from entering the tank or whether one allows them to find it out for themselves. In general we tend to allow people to find this out for themselves with caution in the above categories.

Some people do not have the discipline necessary for effective tank use. This seems to be a matter of intuitive clinical judgment rather than a categorical imperative. In general we have not allowed people with a hostile "acting-out" kind of personality to use the tank. (As Walter Gibson showed in *The Boat* [see Chapter Nine], certain people tend to pull the drain plug in the bottom of the boat, sinking everybody else along with self.)

The tank room or building must have a secure lock on the door to prevent accidents or apparent accidents by hostile persons. We have found that certain persons need an inside lock on the tank room in order to feel safe while they are in the tank. We provide this but we also make sure that it is a lock that can either be broken from the outside, or opened from the outside in case of an emergency. Strangers must be prevented from blundering into the tank room while a person is in the tank.

We have found empirically that the following rules give best tank use and allow many people to use the same tank, during a given twenty-four-hour period.

1. Each person involved must remove his/her clothes and take a very thorough shower, including shampooing his/her hair.
2. Before the shower, urine and feces must be eliminated.
3. If the shower is at some distance from the tank, a bathrobe, which is frequently washed, is furnished to the subject.
4. Each new subject is introduced to the technique of floating on one's back and of placing one's hands, intertwined in the hair, behind one's head, with the elbows immersed in the solution. This technique allows one to feel safer during certain kinds of experiences and should be emphasized with each new subject.
5. If the person intends to sleep in the tank, a safe float for the head should be introduced to him/her so that if the head tends to turn over, the buoyancy of the float tends to keep the head upright. Certain kinds of dreams lead to action of the body that can be balanced out by means of the float.
6. On emersion from the tank the person is asked to stand in the tank and drain as much of the Epsom salts solution from the body as can be done, including squeezing his/her hair so that the solution runs back into the tank, rather than being tracked out outo the floor.
7. On emersion from the tank, either a towel is used or one immediately walks to the shower and gets rid of the Epsom salts in the hair and on the body. Since one has shampooed his/her hair before immersion in the tank, after emersion simple rinsing of the hair with water will get rid of most of the Epsom salts; some people wish at this point to shampoo again.
8. It is wise for most new subjects to write up their experience in solitude immediately after emersion in order for them to pin down their experience and not forget any of it.
9. Many persons tend to get quite loquacious after a tank trip. This can be handled according to local custom. We tend to discourage it in our environment so that they will reserve the energy to write up or to integrate their experience in their normal gravity-loaded environment.
10. Such things as psychological testing, E.E.G's, and so forth

are discouraged in our particular research; however, other research groups may wish to carry out such procedures. We have found that such procedures disturb the learning that takes place in the tank situation.
11. Any write-ups that persons make at our installation are protected in the sense that they are allowed to say whether or not these can be used for publication or for further transmission of the information. We have a sheet at the bottom of which the subject makes his own choices. We realize that subjects tend to censor their own experiences when writing them up for others. We accept this limitation on our data and realize that it is very important for the individual to do this for his own benefit and his own discretion.
12. We tend to dissuade those who wish to use the tank in the service of their own egos, both in terms of their own personal learning and in terms of others' use of the data from subjects in the tank.
13. We try to eliminate all aspects that could be considered coercive in this particular research setting. We do not force subjects to go into the tank, either by persuasion or by hierarchical social position. Strictly voluntary use both as to starting time and emersion time within the limits of the social structure surrounding the tank is absolutely necessary.
14. No therapy nor therapeutic aims by others than the person himself/herself alone are expressed or allowed to be expressed by other persons before or after tank exposure. Persons using the tank are not "patients"; they are peers and self-teaching "students."

CHAPTER TWELVE

Isolation Tank Construction and Maintenance

STEVEN CONGER

When one is ready for experiences in an isolation tank, one has the alternatives of building one, buying one, renting one, or having one built.

Renting time for some experience in a tank might seem a logical first step before committing oneself to the greater expense of building or buying. There are as yet only a few locations with tanks available for public use. Some persons are finding that by renting out their tank, they can pay for it and its maintenance. As the number of tanks available increases, renting may become easier.

As far as buying tanks is concerned, the possibilities are at present also limited. I sell a plywood vinyl-lined tank that can be put up in about two hours. The inside finished dimension of this model at the bottom is 5′ × 7½′. The cost with filter, heating and ventilation systems is about $550 (1975). For information write:

Leela Designs
c/o Steve Conger
130 S. Birch Street
Denver, Colorado 80220

213 Sam Hill Road
Guilford, Connecticut 06437

One alternative is models sold commercially. Write to:

Glenn Perry
Samadhi Tank Company
2123 Lake Shore Drive
Los Angeles, California 90039

Another alternative is to have one built. As far as I know, I am the only custom tank builder. There may be others within a year or so. I build the tanks described in this chapter. I have developed other designs and can adapt a design for your specific requirements. Write me at the address given previously (Leela Designs).

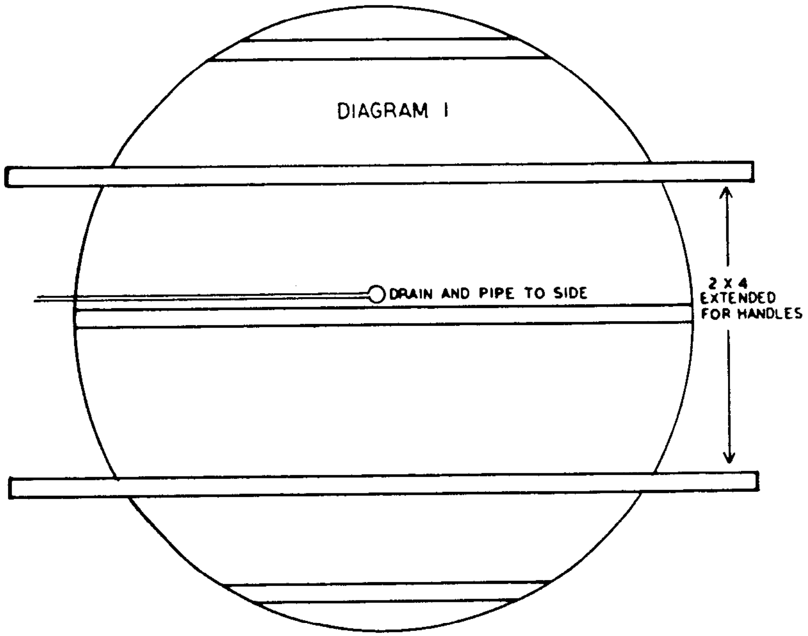
The fourth alternative is to build your own tank. The designs included here have both been experimentally checked out and have operated satisfactorily for six months to a year.

SPRAYABLE POLYURETHANE FOAM MODEL, NUMBER 310874

The construction of the foam tank requires the use of a foam contractor for half a day. The appearance is strikingly novel. When I built my first one, visual descriptions of dispassionate observers seemed to center around the image of a large partially embedded meteorite. The acoustic and thermal insulation is excellent. It is a round tank with circulating jets, which allow a slow spinning motion of the solution that centers the body away from the walls.

Materials for Foam Tank Construction

Two—¾″ or ⅝″ sheets of 4′ × 8′ plywood
Four—2″ × 4″, 10′ long
Construction plastic for the inflatable mold
1 drain (plastic)
50′ plastic pipe (¾″)
1 large roll duck tape
1 piece vinyl—4′ × 4′
Expanded metal or chicken wire 18″ high × 25′ long
2 gal. vinyl paint
Contact cement



Black foam pipe insulation
15′ of 2″ black plastic pipe
2 waterbed heaters
Temperature controller
Serrated knives or handsaws
1 pump
Shop vacuum cleaner
1 filter
1 fan
Soft foam for fan insulation

1. Build a circular base out of the sheets of ⅝″ or ¾″ plywood. To make the base rigid, nail the cut 2″ × 4″s to the bottom. Two of these can be extended to provide carrying handles (see diagram 1).

2. A drain is placed in a tightly fitting hole in the center with the pipe extending out to the side of the circle underneath the tank floor. Only plastic pipe either rigid or semiflexible should be used (diagram 1).

3. Prepare the circulation system as follows. This is made of the semiflexible ¾″ plastic pipe and pipe fittings arranged as shown in diagram 2. Lay the circulation system aside until foaming day.

4. Make the inflatable. It is necessary to make a form on which to spray the foam until it sets, which takes a minute or so. One way to do this is to build an inflatable form out of inexpensive construction plastic. Cut out gore sections and tape or melt them together. Duck tape works well. Melting the plastic together can be done by covering the two sheets of plastic to be joined with aluminum foil and then ironing them together with a household iron. Diagram 3 is a gore pattern that will make a dome-shaped tank 8′ in diameter and 55.4″ high.

5. The materials to have on hand for foaming day (see Materials for Foam Tank Construction list):

DIAGRAM 2

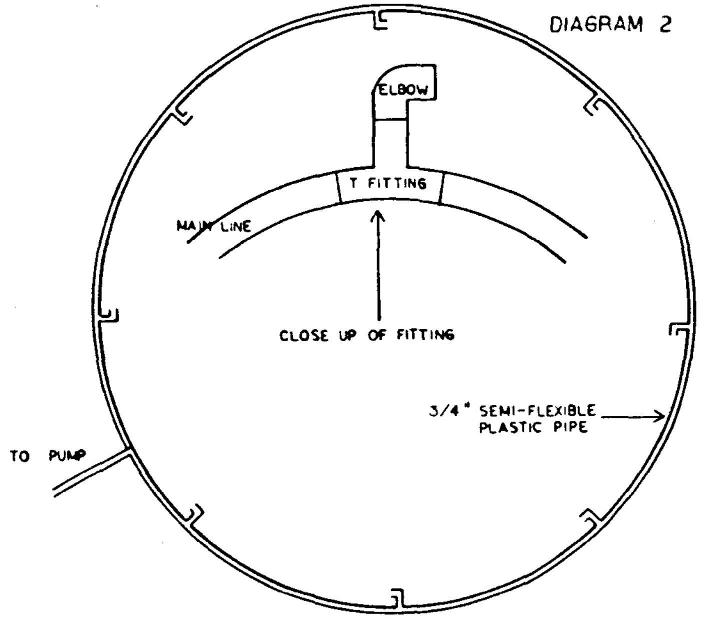
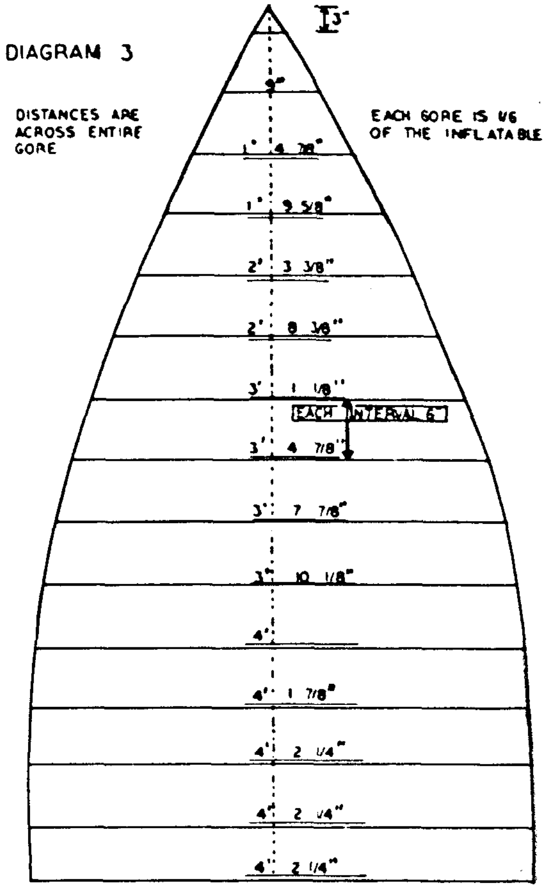


DIAGRAM 3



a. Two one-foot pieces of 2″ black plastic pipe to foam to the wall for ventilation.
b. Serrated knives or old handsaws to cut away excess foam.
c. Duck tape, 100-foot roll.
d. A shop vacuum cleaner is used to blow up the inflatable form: outlet is connected to the form.
e. Two waterbed heaters.
f. Vinyl for the floor.
g. Expanded metal or chicken wire 18″ high × 25′ long.

6. High density and normal density foam are required. You should inform your foam dealer of the type of foam needed before he makes his delivery.

Foaming Day

1. Turn the base over and spray the bottom with 2" to 3" of normal density to make the base rigid and waterproof. Turn the base back over.
2. Place the waterbed heaters on the base as shown in diagram 3a. Cut the vinyl in the shape that extends past the heaters as shown above. Contact cement these vinyl pieces to the base over the heaters.
3. Put the circulation system in place. Hold it with bent nails or wire.
4. Foam the floor with 1" to 1½" of high density foam to about 2" from the heater. Have the foam cover all the circulation system except the jets themselves.
5. Tape the inflatable form to the bottom about 3" in from the outside edge.
6. Hook the vacuum cleaner to the inflatable and inflate.
7. Spray the inflatable with a light coat of high density foam.
8. Wrap the bottom 18" with chicken wire or expanded metal and foam in with normal density foam.
9. Spray the entire dome with normal density foam to a thickness of 4".

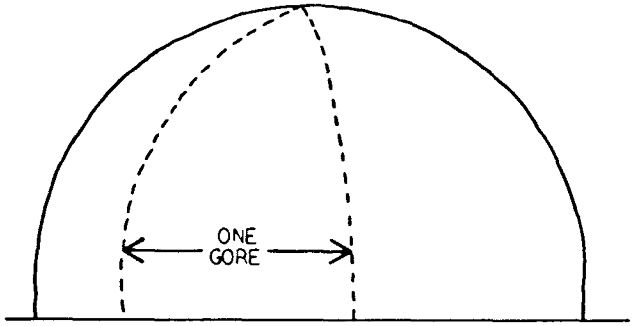


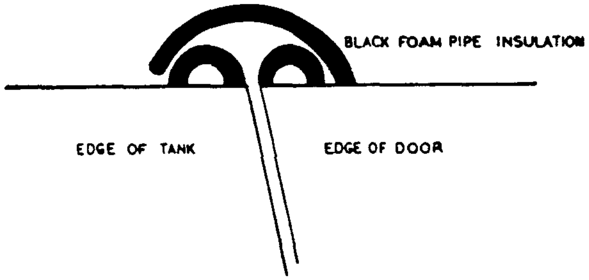
DIAGRAM 3A

10. Coat the outside with a light coat of high density foam for durability.
11. Cut out a door by using a needle-nosed saw. Cut out a circular hole 3′ in diameter. Angle the saw slightly in toward the center of the circle while cutting the opening. This hole and its door are to be lightproofed.
12. There is a choice as to how to approach finishing the door. The first method is to foam handles onto the inside and outside of the piece that has been cut out. One disadvantage to this method is that the foam exposed from cutting out the door will be ragged and easily damaged from heavy use. This can be corrected by many coats of latex paint or a few coats of liquid vinyl paint. Vinyl swimming pool paint works well also.

The second alternative to finishing the door is to remove the door piece and spray the edges of the door hole with high density foam. Next, cover these edges with duck tape, construction plastic or mold release and cover the rear of the hole with plastic. Fit a handle into this plastic backing for an interior handle. Spray this with high density foam. Switch to normal density foam and fill out the door, foaming in the outside handles. Coat the outside of the door with a thin coat of high density. To lightproof the door in this kind of tank use black foam pipe insulation about 1½" to 2" inside diameter. Cut the pipe insulation foam in half on a bandsaw and contact cement, overlapping layers of it as shown in diagram 4.

13. If the tank is going to be outside, the exterior should be

DIAGRAM 4



painted to protect the foam from ultraviolet damage. Painting the inside flat black assists considerably in lightproofing by absorbing any stray photons that enter.

14. The tank is finished. Hook up the water-heating, circulation and ventilating systems. For information on these, refer to the instructions applicable to all models at the end of this chapter.

PLYWOOD TANK WITH VINYL LINER

Materials for Plywood Tank

3 lbs. bonding galvanized finish nails
6 sheets ⅝" exterior grade, one side finished plywood
8 pieces—1" × 3", 19' long
9 pieces—8' long 2" × 3" (or what lumberyard calls 2" × 3")
1 vinyl liner
2 qts. good wood glue
50 number 10 × 1¼" brass wood screws
One latch for lower door
1 gal. flat black latex paint
2 gal. polyurethane
Fittings for air and filter system
2 waterbed heaters
1 fan
Soft foam for fan insulation
10' of 2" black plastic pipe with elbows (for fan)
1 filter
15' of ¾" flexible pvc (polyvinylchloride) hose for filter
Piano hinge
Eight lag bolts
Aluminum channel edging
Pipe-joint compound or Teflon tape

Plywood tanks with vinyl liners can be relatively easily constructed. Because of the nature of the material, these tanks have so far been rectangular. The 4' width of the plywood sheets has usually determined the maximum width and height of these tanks.

(Another model for more space for larger persons is a 5' × 7½' tank. The construction difficulties and the cost are greater.) Assuming, however, that most people will be interested in the simpler and smaller version, here are the plans for a 3½' × 7½' tank (inside dimensions):

1. Take one 4' × 8' sheet of plywood. Cut down to 8' × 3' 6". Cut 2" × 3"s (actual dimension may be less because of lumber labeling) and attach to the edge of the plywood (diagram 5).
2. To attach the 2" × 3"s, first apply a bead of glue. Next, use just enough finish nails to hold the 2" × 3"s in place. Turn the bottom over and nail from the bottom.
3. For the back, cut a piece of plywood to 4' × the measurement for the front and back piece shown in diagram 5.
4. For the front:

   a. Cut a piece of plywood to 3' high by the measurement in diagram 5.
   b. Cut a door in the front and attach a piano hinge (diagram 6).
   c. Cut a light trap for the front door opening. The light trap

DIAGRAM 5

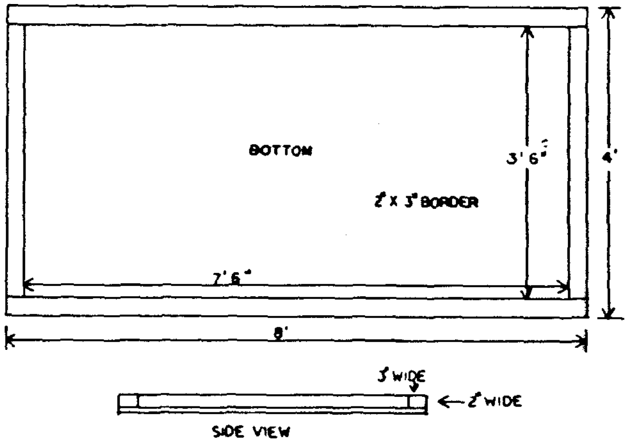
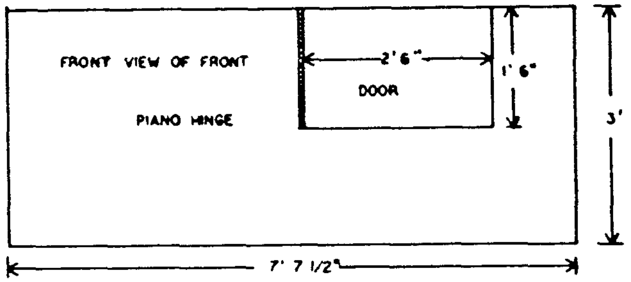


DIAGRAM 6



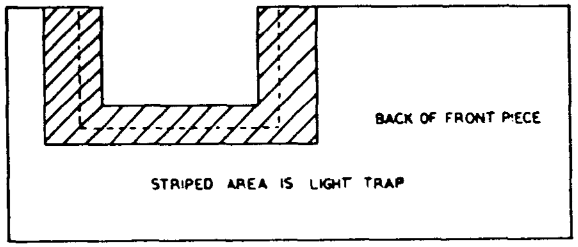
is the striped area in diagram 7. It is a piece cut from ⅝" plywood. It extends two inches past the door opening so the door closes against it. Do not attach this piece to the front until later. Fill the edges of the light trap with plastic wood if necessary. Paint it flat black and coat it with two coats of polyurethane.

5. For the two sides, cut two pieces as shown in diagram 8.

6. Before working on the top, assemble the pieces you have already made. The sides should fit nicely into the bottom frame. Tack into place with a few small nails.

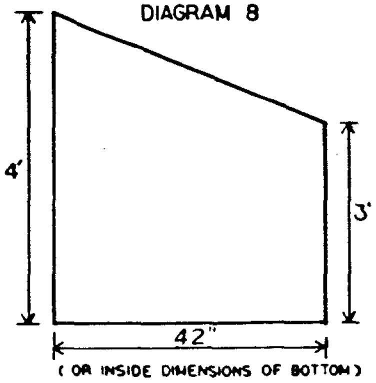
DIAGRAM 7

DOTTED LINE IS DOOR OUTLINE



SAVE THE PIECE CUT OUT TO PUT ON DOOR

DIAGRAM 8



7. For the top:

   a. Cut one 4' × 8' sheet of plywood to 4' × 7' 10¼".
   b. Rip two 8' 2" × 3"s on an angle as shown in diagram 9. Cut them to 7' 10¼".
   c. Attach one of the angled 7' 10¼" 2" × 3"s to the plywood with glue and nails in the manner described in no. 2. Attach it to the long edge (diagram 9). With the 2" × 3" from 7 (b) attached, lie the 4' × 8' top piece over the assembled tank, hanging it from the 2" × 3" as shown in diagram 9. Allow equal overhang on either end.
   d. Draw a line on the bottom face of the top ¼" out from and parallel to the front. This line marks the inner edge of where to attach the next angled 2" × 3" to the top.
   e. Draw lines on the bottom face of the top piece ⅛" out from either side wall of the tank.
   f. Take the top off and place it with the lines you have just drawn facing up.
   g. Take the second 7' × 10¼" 2" × 3" and put its edge outside the line you have just drawn ¼" from the front (diagram 10). Mark the outer side of the 2" × 3" on the plywood and trim the plywood to this line if necessary. Attach the second angled 2" × 3" to the top as in diagram 10. Take 2" × 3"s and attach to the sides of the top (diagram 10). Put the top on the rest of the tank.

DIAGRAM 9

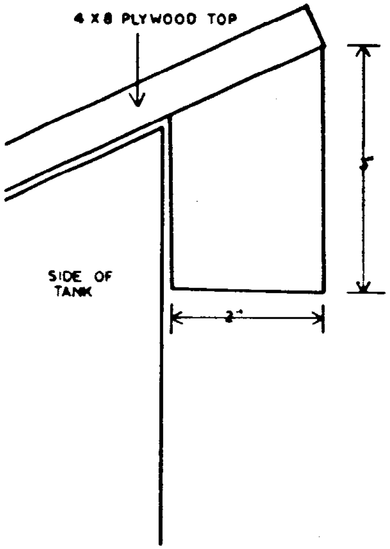
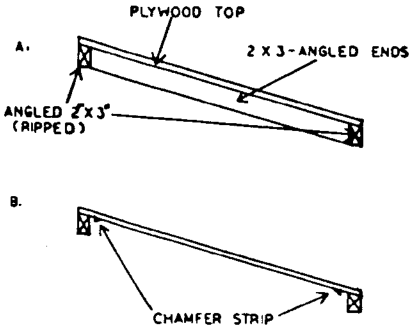


DIAGRAM 10



h. Draw a line around the tank along the bottom edge of the top piece.

i. Starting 3" out from the front door opening (diagram 11) lay out the cut for the top door opening with a square. The opening should be 2½' deep.

j. Take the top off and cut out the top door opening. Saw through the 2" × 3"s also. Watching for nails, attach the second piano hinge along the back edge of this door.

k. Cut a light trap for the top opening in the same way as described in 4c. A space has to be left between the top light trap and the lower angled 2" × 3" to provide a slot for the front wall (diagram 10b). A good way to fit the top light trap is to put the top back on, get into the tank, fit the light trap and mark its placement leaving about ¼" extra for the liner and the liner edging. A 45° chamfer strip should be attached to the top with glue and small nails (diagram 10b). Paint and polyurethane the light trap as you did the one in 4c. Remove the top. Paint the bottom of the top flat black. Paint the bottom of the top with two coats of polyurethane. Attach the light trap with glue and screws.

8. Using glue and nails, attach the 2" × 3"s around the tank below the line that you drew in 7h. (See diagram 11.) This band has to break and be cut for the door opening. On the hinge side of the door it has to have an angle cut. (See diagram 11.) These 2" × 3"s should be attached with the 3" side to the plywood. The way that these 2" × 3"s are fastened to each other is with two lag bolts with washers in each corner. These eight bolts are the only hardware necessary to hold the entire tank together. When they are removed, the tank can be broken down into six flat pieces for moving.

9. Attach with glue and screws the 1" × 3"s that lightproof the corners. Attach as in diagram 12. Do not join the 1" × 3"s to each other.

10. Drill holes for the filter and ventilation systems. In the side of the tank drill one filter hole as in diagram 11, 4" or 5" above the tank floor toward the back of the tank. This is the intake hole. The other filter system hole should be in the same side of the tank about 12" above the bottom toward the front of the tank. Still in

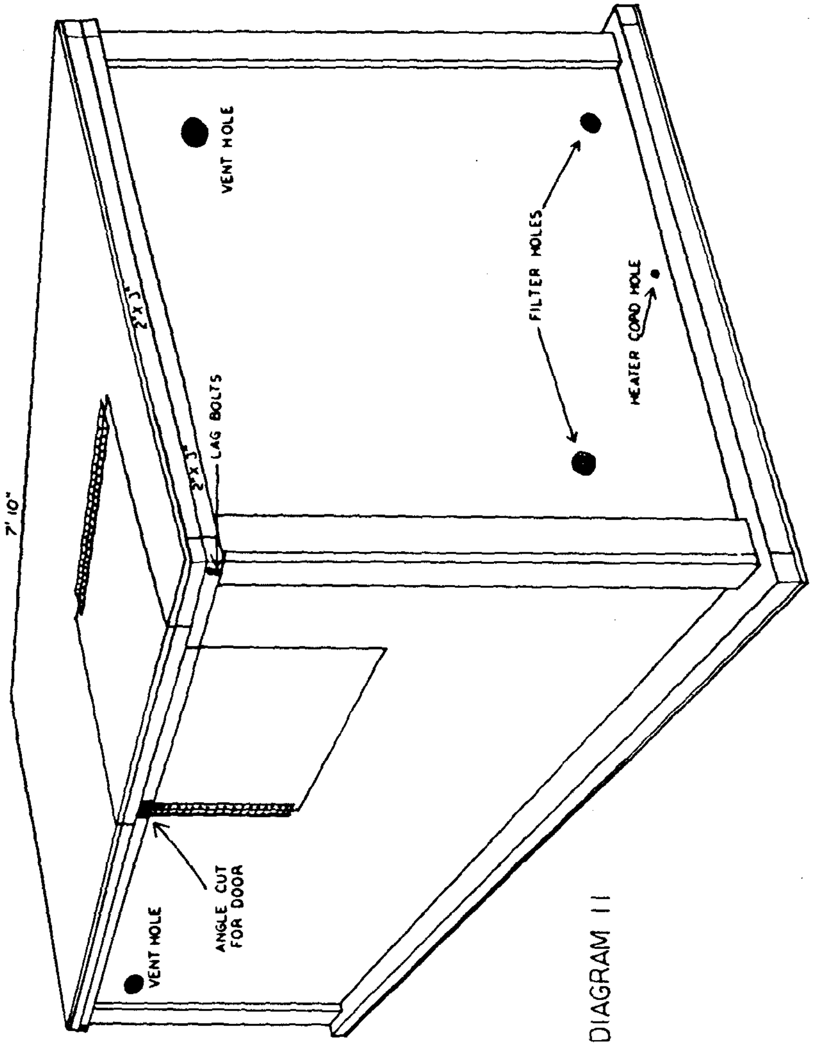


DIAGRAM 11

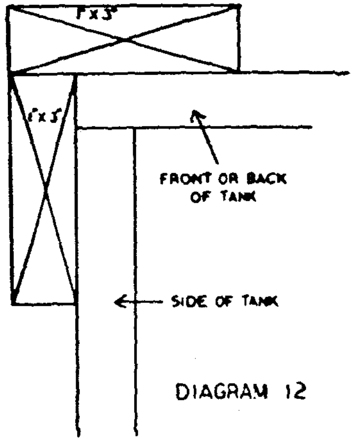


DIAGRAM 12

the same side, toward the back and near the top, drill one ventilation hole 1½" in diameter. This hole should be high so that no draft from the fan is felt. The second ventilation hole, the outlet, should be placed in the top left-hand side of the front (diagram 11).

11. Paint the inside flat black. Paint these parts with polyurethane.

12. When the polyurethane is dry, put the waterbed heaters on the bottom, running the cord out the small hole you drill in the end (diagram 11). Set the vinyl liner in place. (For purchase of the vinyl liner, contact Leela Designs at the address listed earlier in this chapter.) Fold the excess of the liner over the top edge of the tank. Put the aluminum channel edging around the top to hold the liner. Trim the liner leaving a couple of inches extra all the way around. Cut the liner to the edge of the door opening.

13. The front door light trap can now be installed with screws. Do not use glue. Try to get a tight fit against the inside of the front panel.

14. Put the top back on and paint or stain the outside of the tank. I suggest Watco black Walnut-Satin stain. Paint the outside with two coats of polyurethane.

15. Set in the fittings for the pump and ventilation systems. The fittings are plastic as should be all the plumbing in a tank. The fittings are as illustrated in diagram 13, and are available from Leela Designs or S. A. Piping Systems, Alhambra, California. Make the

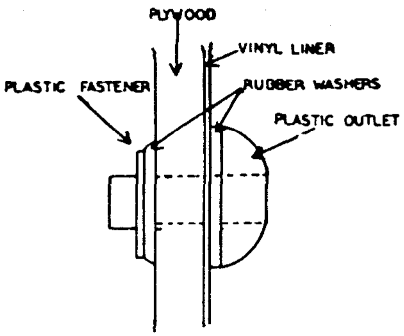


DIAGRAM 13

holes in the liner as small as possible when installing fitting. Only one will be below water. Install this one carefully. Tighten it well and apply pipe-joint compound or Teflon tape to the threads.

16. Be very careful of your vinyl liner. Even a small hole in it can cause a flood. This means avoiding tracking in gravel and being careful with long finger- or toenails. If you do have a leak, there are some waterbed patch kits designed for use underwater.

Filter Systems

Most filter systems for tanks have been of the simple type pictured in diagram 14.

This system is better than nothing but is unsatisfactory. We are now researching more sophisticated models but they are still experimental.

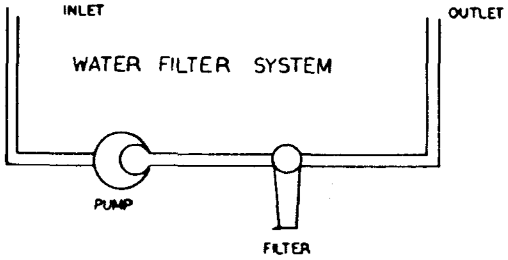


DIAGRAM 14

All components of the system that come into contact with the solution should be plastic in order not to be harmed by the $MgSO_4$ in the water. The use of copper pipe can be dangerous.

Insert plastic pipe fittings with stainless steel clamps are available most everywhere and are easy to use. (Montgomery Ward carries the fittings and the black plastic semiflexible pipe.) The pumps for a noncirculating system haven't been very large (300–500 gallons/hour). The larger the pump the more the turbulence that is created (desirable). A fair amount of turbulence is necessary to filter the epidermal skin that falls to the bottom of the tankshed.

The pump for the circular foam tank with the system designed to slowly circulate the solution must be fairly large. The pump has to be separated from the tank by a long rubber flexible hose to avoid noise transmission from pump to tank.

In the system using jets to spin the body, a sediment filter is placed on the outflow side of the pump as in the other system. Any pumps that you use in any of these systems should be well grounded or are preferably of the magnetic link type of pump.

The sediment filter is a Plexiglas housing that takes a tube-shaped insert of crosshatched nylon cords through which the water passes. Montgomery Ward carries these for about $20. Many plumbing supply stores have them for a little more. One arrangement is to build a five-sided box that contains the pump and filter. The water in the tank should be filtered often to extend the useful life of the Epsom salts solution.

Manual filtering by means of a nylon swimming pool leaf net is used to clean the surface and the large debris carried in on feet.

Ventilation Systems

The positive pressure ventilation system consists of a small, quiet fan, a box with foam baffles to dampen the sound of the fan, and plastic pipe to get the air to the tank (diagram 15). An exit vent of black plastic pipe with at least two elbows in it for lightproofing is also used.

One thing to remember is that only a small air flow is necessary; too much cools the tank air and the skin of the body inside it. Noticeable draft should also be avoided.

FOAM BAFFLE BOX

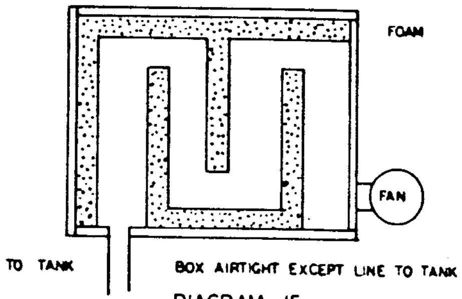


DIAGRAM 15

Heating System

It is very important that the heating system be of good quality. Temperature is one of the most important variables in the tank. Too cold air flow is very active and can quickly drain body heat. Too hot can be dangerous (see Chapter Eleven on standards for isolation tanks).

We use two conventional waterbed heaters to heat the tanks. These go under the vinyl. The conventional waterbed heating controls, however, are not accurate enough. Most have a temperature swing from 2° to 5°. The right temperature is 93° to 94°; 92° is too cold and 95° is too hot. The alternatives to the usual waterbed controls that we have found are more expensive, but extremely good and worth the investment. Temperature control of ±0.1° is possible. The temperature controller or thermoregulator has a sensor that hangs in the water. The sensor is soft and waterproof and completely safe.

The thermoregulator that we have used longest (two years with five instruments in use) is the Gilson, available for $375 from the Gilson Medical Electronics, Incorporated, 3000 West Beltline, Middleton, Wisconsin 53562, telephone (608) 836-1551. The Gilson price includes a sensor.

A small hole has to be drilled in the top of the tank for the probe.

In the case of a foam tank, a hole can be drilled in the side. The probe should hang with the tip in the solution.

To initially calibrate your thermoregulator, obtain a scientific thermometer (see standards in Chapter Eleven for 0.1° calibrated thermometer). Use a small container of water at desired temperature of 93½°. Adjust the thermoregulator so that this is the temperature that flips the current on. A small light plugged into the AC outlet (where you plug in the heaters) facilitates this.

Use the thermometer to periodically check the tank temperature in the solution and see that the desired temperature is being maintained. A repeated warning—don't use the tank if the temperature is too hot.

An effect that we've noticed with the use of waterbed heaters is that the wiring pattern creates a slight purely electrostatic field over and in the solution. A few persons are sensitive enough to detect this when grounded: insulate the floor around the tank to avoid this effect.

For general electrical safety, the floor around the tank is covered with a waterproof insulator such as closed cell foam (polyethylene) or nonporous rubber.

Filling the Tank

The tank is filled with 10" to 12" of water; 10" is a critical depth to avoid bottoms touching. The more the depth, the more Epsom salt and the more is the expense. Enough Epsom salt is needed to bring the density to the saturated value of 1.30 (see table in Chapter Two). About one-half of weight of commercial Epsom salts is water (see table in Chapter Two).

John has been experimenting with the increased density (1.3) solutions and this works beautifully. The need for any head support is eliminated. The weight of hydrated salts is approximately equal to the amount of the water by weight (Chapter Eleven). For the plywood tank, 950 lbs. For the round one, a little more. See Chapter Eleven for measurement of the density of the solution.

Epsom salts can be obtained in 100-pound bags relatively cheaply. Sources can be hospital supply outlets or chemical companies such as Van Waters, and Royers, both in Los Angeles. Each time you change the solution it will cost from $80 to $100 (1975). With regular use, depending on the efficiency of the filtering system, the solution might have to be changed every two to three months to a year. If an adequate diatomaceous earth filter (swimming pool) is used, the solution can be kept clean indefinitely. For those interested, seawater is 2.8 percent sodium chloride (NaCl) and 0.4 percent magnesium sulfate ($MgSO_4$, or Epsom salts). Epsom salts are preferable to sodium chloride because they are less irritating to the skin, and hence are used in medical treatment of sprains, etcetera. We've tried sodium chloride and sea salt and definitely prefer Epsom salts.

When filling the tank, it is good to fill it with water at the correct temperatures to avoid waiting for the water to heat up. This means dissolving the Epsom salt early. The reaction of $MgSo_4$ with water is highly endothermic (heat absorbing). If the tank is filled with water at the correct temperature and then the Epsom salts are added, a good deal of temperature is lost. First, put all the salts into the tank and dissolve them with hot water (140°F).

Draining and Cleaning

Some ways to drain a tank are a siphon, a waterbed drainer, available at waterbed stores, or the filter pump used as a drain pump.

The tank should be cleaned with detergent and water between fillings.

An Environment for Your Tank

Making your tank room visually pleasing is nonessential but nice. Will Curtis's mandala paintings are on our roof and walls, plus astronomical posters. I am now building a tank for someone who is creating an "amphibian transition" environment. Soft, nonglaring lights in the room are a good idea. All of this may be irrelevant once you are in the tank. More obviously functional equipment for your tank room are a shower, a toilet and an air-space heater.

Showering is necessary before entering the tank to preserve the useful life of the solution. Showering after immersion in the tank is necessary to wash the salt off.

A toilet or porta-potty in the room is handy. Urinating in the tank is obviously unpleasant and nonhygienic (urine is not removed by the filter). Some people are confused about this because of John's discovery of the time of totally nonrepressed spontaneous bladder evacuation as reported in *The Center of the Cyclone*. This discovery was made in a very large tank with water at the correct temperature flowing continuously through it.

A heater in the room is needed; it warms the air going into the tank and avoids chilling when the subject showers or emerges from the tank. We keep the room at 86°F (warm for active persons wearing clothes).